

CLAIMS

What is claimed is:

1. A metrology device comprising:
 - a polarization state generator, including an electromagnetic source, the polarization state generator produces an electromagnetic beam of known polarization state that is incident on a sample;
 - a spatial variable phase retarder in the path of the electromagnetic beam after the sample;
 - a polarizing beam splitter in the path of the electromagnetic beam after the spatial variable phase retarder, the polarizing beam splitter into a first beam having a first polarization state and a second beam having a second polarization state that is orthogonal to the first polarization state; and
 - a first set of detector elements within the path of the first beam after the polarizing beam splitter and a second set of detector elements within the path of the second beam after the polarizing beam splitter, wherein the first set of detector elements and the second set of detector elements measure the intensity of the first beam and second beam, respectively, as a function of position.
2. The metrology device of Claim 1, further comprising a beam expander within the path of the electromagnetic beam before the spatial variable phase retarder.
3. The metrology device of Claim 1, wherein the polarizing beam splitter is a displacer.
4. The metrology device of Claim 1, further comprising:
 - a first aperture before the polarizing beam splitter;
 - a second aperture before the first set of detector elements; and
 - a third aperture before the second set of detector elements.
5. The metrology device of Claim 1, wherein the first set of detector elements and second set of detector elements are detector elements in a detector array.
6. The metrology device of Claim 1, wherein the first set of detector elements and second set of detector elements are separate detectors.

7. The metrology device of Claim 1, further comprising a means for summing the intensities of the first beam and the second beam.
- 5 8. The metrology device of Claim 7, further comprising a means for normalizing the first and second polarizing beam using said summed intensities.
9. The metrology device of Claim 8, wherein said means for summing the intensities and means for normalizing is a computer system coupled to the first set of detector
10 elements and second set of detector elements, the computer system receiving signals indicative of the intensity of the first beam and the second beam, the computer system having a computer-usable medium having computer-readable program code embodied therein for:
- 15 summing the intensities of the first beam and the second beam; and
 normalizing the first and second polarizing beam using said summed intensities.
10. The metrology device of Claim 1, further comprising at least one relay lens disposed between the polarizing beam splitter and the first set of detector elements and the second set of detector elements.
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11. A method of ellipsometrically measuring a sample, the method comprising:
- producing an electromagnetic beam to be incident on a sample;
 polarizing the electromagnetic beam prior to being incident on the sample;
 producing a spatially dependent relative phase difference between the
25 electromagnetic field components of the electromagnetic beam after the beam is incident on the sample;
 splitting the electromagnetic beam after a spatially dependent relative phase difference is produced into two beams having orthogonal polarization states; and
30 detecting the intensities of the two beams having orthogonal polarization states at a plurality of positions.
12. The method of Claim 11, further comprising expanding the electromagnetic beam prior to producing a spatially dependent relative phase difference.

13. The method of Claim 11, further comprising summing the intensities of the two beams having orthogonal polarization states.
- 5 14. The method of Claim 13, further comprising using the summed intensities by normalizing the produced electromagnetic beam.
15. An apparatus for measuring a characteristic of a sample, the apparatus comprising:
- 10 a light source producing an electromagnetic beam;
a polarizer in the path of the electromagnetic beam, wherein the polarized electromagnetic beam is incident on the sample;
means for producing a spatially dependent phase shift in the electromagnetic beam after the electromagnetic beam is incident on the sample,
15 the means for producing a spatially dependent phase shift producing a phase shifted beam wherein the phase shift is spatially dependent;
means for splitting the phase shifted beam into a first beam and a second beam, wherein the first beam and second beam are orthogonally polarized;
means for measuring the intensity of the first beam and the second beam,
20 the means for measuring being in the path of the first beam and the second beam;
and
means for summing the intensities of the first beam and the second beam.
16. The apparatus of Claim 15, further comprising a means for expanding the electromagnetic beam, the means for expanding being in the path of the electromagnetic beam before the means for producing a spatially dependent phase shift.
- 25 17. The apparatus of Claim 15, wherein the means for producing a spatially dependent phase shift comprises a spatial variable retarder.
- 30 18. The apparatus of Claim 15, wherein the means for splitting the phase shifted beam into a first beam and a second beam comprises a displacer.

19. The apparatus of Claim 15, wherein the means for splitting the phase shifted beam into a first beam and a second beam comprises a polarizing beam splitter.
20. The apparatus of Claim 15, wherein the means for measuring the intensity of the first beam and the second beam comprises a first set of detectors that receive the first beam and a second set of detectors that receive the second beam.
21. The apparatus of Claim 20, wherein the first set of detectors and the second set of detectors are elements in a detector array.
22. The apparatus of Claim 20, wherein the first set of detectors and the second set of detectors are separate linear detectors.
23. The apparatus of Claim 15, wherein the means for summing the intensities of the first beam and the second beam comprises a computer system coupled to the means for measuring the intensity of the first beam and the second beam, the computer system receiving signals indicative of the intensity of the first beam and the second beam, the computer system having a computer-usable medium having computer-readable program code embodied therein for summing the intensities of the first beam and the second beam.
23. The metrology device of Claim 15, further comprising at least one relay lens disposed between the means for splitting the phase shifted beam and the means for measuring the intensity of the first beam and the second beam.